INTERNATIONAL JOURNAL OF CURRENT RESEARCH IN CHEMISTRY AND PHARMACEUTICAL SCIENCES

(p-ISSN: 2348-5213: e-ISSN: 2348-5221)

www.ijcrcps.com Coden: IJCROO (USA)

Research Article

COMPARATIVE STUDY OF TOTAL CHOLESTEROL AND TOTAL PROTEIN LEVELS OF CHICKEN AND QUAIL EGGS PRODUCED IN BENUE STATE, NIGERIA

IKESE OCHE CHRIS*[1], DONALD TYOKER KUKWA[1], LENKA JESSICA LAPSHAK[2], ADOGA SUNDAY OGAKWU[1] AND INALEGWU EKALU[1]

[1]Benue State University Makurdi, Department of Chemistry. P.M.B 102119, Makurdi, Nigeria
[2]University of Jos Nigeria, Department of Biochemistry. P.M.B 2084, Jos, Nigeria
*Corresponding Author: chrisjieng@gmail.com

Abstract

The study compared the total cholesterol and total protein levels of chicken (*Gallus domesticus*) and quail (*Coturnix japonica*) eggs produced in Benue state, Nigeria. Twenty five (25) eggs each of chicken and Quail from different poultry farms were analyzed by enzymatic-colorimetric method using a UV-Visible Spectrophotometer. Whereas only the egg yolk was used for total cholesterol determination at 500 nm, homogenized albumen-yolk mixtures of the eggs were diluted with distilled water in a 1 to 9 ratio and reacted with analytical grade color-producing, enzymatic reagent for the total protein determination at 546 nm. The results indicate that the mean total cholesterol levels in chicken and quail eggs from Benue state are 233 mg/egg and 71 mg/egg respectively but on a per gram-yolk basis, quail eggs contain more cholesterol (18.7 mg/g) than chicken eggs (16.5 mg/g). The mean whole-egg mass for chicken and quail eggs were found to be 53.6 g and 8.7 g respectively. The study also revealed that quail eggs contain significantly higher amount of total protein per 100g of albumen-yolk mixture (33.8 g/100g) than chicken eggs (24.4 g/100g). It was therefore concluded that quail eggs despite having a higher total cholesterol level than chicken eggs were nutritionally more valuable to consume because of their higher total protein content especially since the total cholesterol level even when two quail eggs are combined is still far below the daily recommended limit of 200 mg.

Keywords: Total Cholesterol, Total Protein, Benue state, Chicken eggs, Quail eggs.

Introduction

Since the middle of the 19th century, there has been an increase in the demand for avian eggs and their food products (Don & Brothwell, 2009; Larsen & Froning, 2008) especially those of chicken, quail, duck, roe and caviar. Poultry eggs are considered as one of the most preferred poultry products. High nutritive value, better digestibility, low cost and ready availability are some of the reasons for this preference and as such the common and most favored dietary source of protein for low income households, who often times are unable to afford more expensive protein sources (Emmanuel et al., 2011).

Eggs contain proteins of high biological value and other nutrients such as vitamins, minerals, phospholipids and other lipids. However, the egg yolk component is extremely high in cholesterol and is a potential disadvantage in some human diets. Cholesterol, which belong to a class of neutral lipids, is essentially a waxy steroid with a 27 carbon structure (Washburn and Nix, 2004). It is an essential structural component of cell membranes and lipoprotein. It also serves as a precursor for steroid hormones, vitamins and bile acids (Maurice et al., 1994). Cholesterol travels through the blood stream with triglycerides and other fats packaged by the liver in tiny molecular globules called lipoproteins.

There is a link between blood levels of cholesterol and the risk of coronary heart disease in humans (Stamler et al., 2006) via the premature development of artherosclerosis (Oliver, 1990). Prolonged high levels of plasma cholesterol have been implicated in incidences of coronary heart diseases and a notable amount of it exists in egg yolk (Hsu et al., 1995). For centuries now, cholesterol has been implicated in the deposition of cell membrane remnants, oxidized materials and fat, all packaged together as waxy plaques (atheromas) in the arterial walls of blood vessels thereby clogging them and preventing the transport of oxygen and other vital materials borne by blood to various organs and tissues.

This culminates in a medical condition called atherosclerosis (Fernandez, 2010). Also, very low density lipoproteins (VLDLs) are capable of squeezing through the lining of arteries and can be oxidized otherwise known as turning rancid and in this form can cause damage and inflammation to the arteries. Findings from recent studies have drawn attention to the fact that the oxidized form of cholesterol (oxysterol) is very harmful (Shills, 1999). The overall effect of the aforementioned is the onset of Coronary Heart Disease (CHD), Heart attack, stroke and in extreme cases death. Due to its aforementioned harmful effect on health, the National Heart, Lung and Blood Institute under the auspices of the US Department of Health and Human Services has in its national cholesterol education program recommended a daily dietary cholesterol intake of 200 mg (Burke et al., 2007).

There is a growing societal interest in the cholesterol content of foods especially those consumed frequently. Eggs and their related products fall in this category. It is thus imperative to conduct a comparative study of the total cholesterol and total protein levels in chicken and quail eggs as they are the predominantly consumed poultry egg in most communities.

This study aims at comparing the total cholesterol levels in chicken and quail eggs produced in Benue State of Nigeria with a view to recommend which species produces the safest eggs or yield the lowest amount of cholesterol. Based on the foregoing, if the cholesterol levels in the eggs of chicken and quail can be correctly ascertained, especially amidst the growing advocacy for increased consumption of quail eggs, it would lead to making better informed decisions as to the choice of egg to consume and how much of each that can be safely consumed per day. This would stem the tide of elevated blood cholesterol levels, arterial inflammation arising from high levels of plasma cholesterol, atherosclerosis, cardiovascular diseases and subsequent death.

Materials and Methods

The study area was divided into three (3) regions labelled A, B and C. Twenty-five eggs each of chicken (*Gallus domesticus*) and quail (*Coturnix japonica*) were procured from randomly selected poultry farms in each region across the state and conveyed to the laboratory in aerated crates. Analytical grade total cholesterol and total protein determination kits were purchased from RANDOX laboratories. The whole-egg mass of each egg was determined in gram with a weighing balance and recorded.

Total cholesterol determination was carried out by enzymatic colorimetric method using UV-Visible spectrophotometer (Han and Lee, 1992) . The reaction sequence in this method involves the hydrolysis of cholesteryl esters to yield cholesterol and free fatty acids. The former is then oxidized to cholestene-3-one, thus generating hydrogen peroxide which is subsequently utilized in the enzymatic coupling of 4-amino antipyrine and phenol to give an intense blue colored solution which absorbance is measured at 500nm.

In the Total cholesterol analysis, only the egg-yolk of each sample was used for the determination since in eggs, cholesterol is only present in the yolk. In each case, the yolk used was retrieved by puncturing the top end of the egg with a sterile glass rod and the albumen carefully allowed to drain completely into a labelled glass beaker leaving the yolk behind. The shell was then cracked wide open and the yolk dropped onto a clean paper towel and rolled carefully on the paper towel to remove any adhering albumen. The whole-yolk was then weighed and its mass recorded using a fresh paper towel of known weight on a chemical weighing balance.

1mL of the yolk was separately weighed and recorded and 9 mL of distilled water was added to it in a test tube and agitated vigorously to homogenise. 20uL of the homogenised yolk was then added to 1 mL of the cholesterol determination reagent supplied with the cholesterol determination kit procured from RANDOX, shaken well and incubated for 10 mins at 25^{o}C to allow for color development. Both the absorbance of sample and standard were measured at 500 nm using a Perkinelmer UV/Vis spectrophotometer against a reagent blank. The concentration of cholesterol in mg/g yolk was obtained by evaluating the following expression for each egg.

Conc. of cholesterol in sample (mg/g) =

$$\mathbf{A_{sample}/A_{standard} \times Conc.\ of\ standard \times 10 \times 1/W}$$

Where,
A is Absorbance,
W is the mass of 1ml of the homogenised yolk sample and
10 is the dilution factor.

All samples were run in triplicates and the mean values reported. The above procedure was then repeated for the remaining egg samples. Enzymatic colorimetric method was also used in the determination of total protein in the egg samples. The method employed the interaction of cupric ions with protein peptide bonds resulting in the formation of a colored complex. However, in this determination, homogenised albumin-yolk mixture was used as protein is present in both the yolk and albumin of eggs. Also, total protein determination reagent and bovine serum albumin standard both supplied with the Kit from RANDOX were used and absorbance measurement was at 546 nm. However for a more meaningful comparison, the total protein levels were reported in mg/100g of the albumin-yolk mixture because unlike cholesterol, protein is present in both the albumin and yolk of chicken and quail

eggs which also have a naturally huge size variation by virtue of species difference.

Results were presented as mean and standard deviation (SD). Total cholesterol and total protein levels of chicken and quail eggs were compared by student's t-test at $p < 0.05$.

Results and Discussion

The results of the total cholesterol determinations on chicken and quail eggs from Benue State are as presented in Table 1 and 2 respectively. All results are presented as Mean ±SD of triplicate values (n=3). Differences are considered significant at $p < 0.05$.

Table 1: Mean Mass of whole egg, whole yolk and total cholesterol levels in chicken eggs

Farm group	No. of eggs per group	Whole egg mass (g)	Whole yolk Mass (g)	Cholesterol content (mg/g of yolk)	Cholesterol content per egg (mg)
A	9	54.105±1.840	13.879±1.464	16.705±1.029	241.179±14.770
B	8	52.288±3.411	13.319±1.846	15.852±1.522	212.740±43.230
C	8	54.547±1.640	14.459±0.836	17.137±0.761	247.319±9.780
Overall mean ±SD		53.647±2.297	13.886±1.382	16.565±1.104	233.746±22.593

Table 2: Mean Mass of whole egg, whole yolk and total cholesterol levels in quail eggs

Farm group	No. of eggs pe group	Whole egg mass (g)	Whole yolk Mass (g)	Cholesterol content (mg/g of yolk)	Cholesterol content per egg (mg)
A	9	9.376±0.495	3.695±0.175	17.589±2.532	74.284±5.029
B	8	8.502±0.881	3.653±0.145	19.217±0.925	69.789±5.672
C	8	8.283±0.583	3.523±0.090	19.562±0.266	68.944±2.552
Overall mean ±SD		8.720±0.653	3.624±0.187	18.789±1.241	71.001±4.418

Tables 1 and 2 show that the mean total cholesterol level per egg is 233.7+22.5 mg and 71.0+4.4 mg in chicken and quail eggs respectively. These values are similar to those reported by Han and Lee and are regarded as high (Han and Lee, 1992). Also, the observed difference between them is to be expected as naturally, chicken eggs are several times bigger than quail eggs even as seen from the mean whole egg masses of chicken eggs (53.6+ 2.2 g) and quail eggs (8.7+ 0.6 g) in Tables 1 and 2 respectively. As a result of this fundamental difference in physical size and proportion, the total cholesterol level per egg may not be as ideal a parameter as the total cholesterol level per mg of yolk for comparing the cholesterol level in the eggs of the two avian species especially since all the cholesterol in avian egg is found in the yolk.

The result in tables 1 and 2 give the mean total cholesterol level per gram of yolk as 16.5+1.1 mg and 18.7+1.2 mg in chicken and quail eggs respectively. This means that on a gram for gram of yolk basis, quail eggs contain more cholesterol than chicken eggs. However a t-test comparison of the means show that there is a significant difference between them at $p < 0.05$. Table 1 show that the mean total cholesterol level per gram of yolk of chicken eggs in farms A, B and C is 16.7, 15.8 and 17.1 mg/g yolk respectively. The marginal difference witnessed between the farms could be attributed to the use of the same brand of commercial live stock feed (vital feed) in all three farms as that is the most common feed used by most poultry farmers in Benue state, as well as uniformity in bird strain. A similar trend is observed in table 2 with quail eggs where the mean total cholesterol per gram of yolk in farms A, B and C are; 17.5, 19.2 and 19.5 mg/g yolk respectively. Therefore, across the farms, there is really no significant difference in the mean total cholesterol levels per gram of yolk.

The results of the total protein determinations in chicken and quail eggs from Benue State are as presented in Table 3 and 4 respectively. All results are presented as Mean +SD of triplicate values (n=3). Differences are considered significant at $p < 0.05$. Table 3 and 4 give the mean total protein levels in chicken and quail eggs respectively. Also, table 3 and 4 show that the mean total protein level is 24.4+2.4 g/100g egg and 33.8 +2.3 g/100g egg in chicken and quail eggs respectively. These values are quite high and confirm that eggs from both species are excellent protein sources considering the 16 g/100g bench mark for a food source to be considered as rich in protein. A t-test comparison of both means at $P<0.05$ protein content of quail eggs were significantly higher than that of the chicken eggs. This may be attributed to species difference.

Table 3: Mean Total Protein content of chicken eggs from Benue state

Farm group	No. of eggs per group	Whole egg mass (g)	Total protein content (g/100g of egg)
A	9	54.105±1.835	24.267±2.952
B	8	52.955+3.829	23.922+2.564
C	8	54.547±1.640	25.298±1.460
Overall mean ±SD		53.869±2.435	24.496±2.482

Table 4: Mean Total Protein content of Quail eggs from Benue state

Farm group	No. of eggs per group	Whole egg mass (g)	Total protein content (g/100g of egg)
A	9	9.315±0.775	34.230±2.132
B	8	8.748±0.715	33.215±0.754
C	8	9.111±0.862	34.219±4.221
Overall mean ±SD		9.058±0.784	33.888±2.369

For both chicken and quail eggs, differences in the observed differences in mean total cholesterol content and mean total protein level of eggs between the different farms (A,B and C) were marginal as well.

Conclusion

From the results obtained, the study concluded that the mean cholesterol level in chicken and quail eggs from Benue state are 233 mg/egg and 71 mg/egg respectively but on a gram per gram of yolk basis, quail eggs contain more cholesterol (18.7 mg/g) than chicken eggs (16.5 mg/g). The study also concluded that quail eggs contain significantly higher amount of protein per 100g albumen-yolk mixture (33.8 g/100g) than chicken eggs (24.4 g/100g).

Since the cholesterol level per gram yolk in quail egg is comparable to that in chicken eggs, but quail eggs have a predominantly higher amount of proteins and going from related studies, contain a higher amount of unsaturated fatty acids than chicken eggs (Jalaludeen and Churchil, 2006), the study concludes that quail eggs are comparatively safer and more advantageous to consume than chicken eggs. Also going by the small nature of their size, it is easier to keep the dietary intake of cholesterol from quail eggs within the recommended daily limit of 200 mg set by the US Department of Health and Human services. On the basis of the aforementioned benchmark for daily cholesterol intake, the study recommends the consumption of 2 quail eggs per day (142 mg cholesterol) thus leaving room for cholesterol from other dietary sources such as milk, meat etc or on the alternative, not more than one chicken egg per day.

Acknowledgments

The Authors are deeply grateful to the laboratory technologists at the Chemistry Department of Benue state University, Makurdi for their technical assistance in the course of the study.

References

Burke, V., Zhao, Y., Lee, A.H., Hunter, E., Spargo, R.M., Gracey, M., Smith, R.M., Beilin, L.J., and Puddey, I.B. 2007. Health-related behaviours as predictors of mortality and morbidity in Australian Aborigines. Journal of Preventive Medicine. 44, 135-42.

Don, R., and Brothwell, P. 2009. Food in Antiquity: A survey of the diet of early peoples. Maryland, USA, JHU Press.

Emmanuel, T.F., Omale, J., Olajide, J.E., and Baku, A.B. 2011. Variations in micronutrient content and lipid profile of some avian eggs. American Journal of Experimental Agriculture. 1 (4): 343-352.

Fernandez, M.L. 2010. Effects of Eggs on Plasma Lipoproteins in Healthy Populations. Journal of Food and Function. 1, 156-160.

Han, C.K., and Lee, L.N. 1992. Yolk cholesterol content in egg from the major domestic strains of breeding hen. Journal of Korean Food Research Institute. 5 (3), 420-462.

Hsu, H.Y., Nicholson, A.C., Pomerantz, K.B., Kaner, R.J., and Hajjar, L.P. 1995. Altered cholesterol trafficking in herpesvirus-infected arterial cells. Evidence for viral Protein Kinase meditated Cholesterol accumulation. Journal of Biochemistry. 70 (33);19630-7

Jalaludeen, A., and Churchil, R.R. 2006. Duck egg and their nutritive value. Poultryline. 10, 35-39.

Larsen, J.E., and Froning, G.W. 2008. Extraction and processing of various components from egg yolk. Journal of Poultry Science. 60, 160-167.

Maurice, D.V., Lightsey, S.F., Hsu, K.T., Gaylord, T.G, and Reddy, R.V. 1994. Cholesterol in eggs from different species of poultry determined by capillary GLC. Journal of Food Chemistry. 50, 367–372.

Oliver, M.F. 1990. Lipids and coronary disease: resolved and unresolved problem. British Medical Bulletin. 46, 865–872.

Shills, M.E. 1999. Modern nutrition in Health and Disease. 9th edition, Baltimore, USA. Williams and Wilkins publishers.

Stamler, J., Wentworth, D., and Neaton, J.D. 2006. Is relationship between serum cholesterol and risk of premature death from coronary heart disease continuous and graded? Journal of American Medical Association. 56, 2823–2828.

Washburn, K.W., Nix, D.F. 2004. Genetic basis of yolk cholesterol content. Journal of Poultry Science. 53, 109-115.